Project Report

Drivers and Barriers for the Implementation of Integral Capacity Management in Norwegian Hospitals

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SUMMARY
Rising healthcare expenditures call for new ways of working smarter in hospitals to achieve their target performance with the same budget and staffing levels. Integral Capacity Management (ICM) is an approach developed in the Netherlands that helps hospitals achieve their desired performance. It matches patient demand with resource capacity by managing variability without increasing costs. With the question in mind of whether this approach could be implemented in Norway, this report analyses the main differences between the Dutch and Norwegian healthcare systems and identifies drives and barriers for the implementation of ICM in Norwegian hospitals. Overall, the success of implementing ICM in Norway could be less than in the Netherlands due to the mentioned differences between the healthcare systems. However, there is still great potential for improving the current way of planning in Norwegian hospitals, and we believe ICM can highly contribute to this improvement.

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Management abstract

Introduction

Healthcare is under pressure due to an aging population with increasing co-morbidities. As a result, we see an increase in healthcare expenditures and required staffing. Increasing healthcare budgets and employing more personnel is not sustainable. The healthcare sector needs to work smarter to achieve more with the same budget and staffing levels.

This problem is not exclusively a Norwegian problem. Many western societies face the same challenges. In the Netherlands this has resulted in the development of a new way of managing capacity: the Integral Capacity Management (ICM) approach. This approach has been successfully implemented in several Dutch hospitals, and it seems to be a promising approach also for the Norwegian health sector.

The NFR funded project iCope tries to implement ICM in Norwegian hospitals with the objective to break through the silo-ed organization of hospital departments to establish integral planning and control of care chains. This means that the planning and control is done to promote “patient flows”, taking into account all the different departments and how they are connected, as well as the different specialties. This approach allows hospitals to improve the quality and timeliness of care while containing costs.

Goal of the report and contribution

The goal of the report is to assess the feasibility of adapting ICM in Norway. The concrete objectives of this report are to:

1. Explain ICM, highlighting its main characteristics
2. Describe the Dutch and Norwegian healthcare systems and identify the main differences
3. Identify drivers and barriers for the implementation of ICM in Norwegian hospitals

The contribution of this report is that it brings together knowledge of ICM that can hardly be found in the scientific literature. Moreover, to the best of our knowledge, it is the first report comparing two healthcare systems to assess the feasibility of implementing ICM in another country other than the Netherlands. The main target group for this report are hospital managers in Norway as well as clinical staff, researchers and other individuals who are interested in the topic.

Method

To write this report and summarise the essentials of ICM we have a) looked at the scientific literature in books, journal articles and PhD theses, and b) used our own knowledge and experience gained from following ICM-related courses and attending presentations from the professionals in the field. To describe and compare both healthcare systems, we have looked at reports, national databases of statistics, and news articles.

Integral Capacity Management

Capacity planning tries to match the care demand and the care supply (capacity) in order to reach the desired performance. Finding the right balance between demand and supply is very complex because there are endlessly interlocking decisions. Patients flow in a supply chain of departments (outpatient clinic, diagnostics, surgery, wards, etc.), where each department has its own planning, and oftentimes do not consider the upstream and downstream departments when planning (silo-ed organization). The decisions made when optimizing the planning of just one department create an artificial variability

which is amplified in the downstream departments. This leads to a mismatch between patient demand and resource capacity, resulting in unbalanced workloads, long waiting lists, long access times, low productivity, overtime, etc. Therefore, to have a good performance it is essential to have a helicopter view of the hospital and plan the capacity considering all the departments and specialties, and making capacity decisions at the right time, i.e., managing the capacity integrally.

ICM helps hospitals achieve their performance goals while containing costs. This is done by creating a decision structure where capacity planning decisions are made to align resources, taking into account the entire care pathway and different time frames. These time frames are determined by four hierarchical levels of control [1]: the strategic, tactical, off-line operational, and on-line operational levels. One of the main characteristics of ICM is that it introduces this tactical planning level, which is missing or dysfunctional in most hospitals. This enables a translation from strategic to operational decisions, which is essential to align demand and supply. ICM uses decision support tools such as dashboards to visualize both past and future performance data to help make capacity-related decisions across departments and specialties.

Factors contributing to the success of ICM in the Netherlands

Some of the ICM drivers highlighted by the Dutch hospitals are internal factors, such as education, proper communication, creating commitment in the organization, and high-quality information systems support, which are common to most organizational change efforts. They are not related to characteristics of the Dutch healthcare system, and therefore not relevant for this report. Factors that are related to the way the healthcare system is organized and that affect the success of ICM are: governance structure, financing, and social geography. These factors contribute to the success of ICM in the Netherlands as follows:

- **Governance structure**: Even though departments in non-academic hospitals have a considerable level of autonomy, the organization of the Dutch funding system gives the board the responsibility for negotiating production levels and pricing with the insurance companies and achieving production within the budget. This requires central steering and enables cross-departmental planning.
- **Financing**: In the Dutch system the income for hospitals is closely related to the hospital's production. Production levels are negotiated with insurance companies, as well as cost levels. This means that the incentives for reaching production while minimizing costs are high.
- **Social geography**: In the Netherlands most live near one or more hospitals. This makes it possible for hospitals to share patients to spread the workload, and also facilitates the specialization of hospitals by focusing on a specific patient group. With these two strategies, variability can be reduced and planning improved.

Drivers and barriers of ICM implementation in Norway

The factors contributing to the successful implementation of ICM in the Netherlands do not necessarily imply drivers for the implementation in Norway. The biggest differences between the Dutch and Norwegian healthcare systems and how these can have an impact on the implementation of ICM in Norway are summarised below.

- **Governance structure**: The majority of the Norwegian healthcare sector is under public control, which implies a more centralized planning and control than the Dutch. This together with public ownership of hospitals through the regional health authorities means that these bodies have the steering ability to change and direct hospitals to go into certain directions. If used properly, this power has the potential to be strongly centralized, which facilitates the success of ICM.

- **Financing**: Norwegian hospitals are funded by a 60% lump sum payment and a 40% productivity related (DRGs) payment. The money is paid by the government to the regional health authority, who distributes the money to the respective hospitals. This means that the economic incentives to increase productivity and/or lower costs are lower than in the Netherlands.
- **Social geography**: The extensive area, challenging topography, low population density and sparse population separated by long distances, force hospitals to provide service to all their surrounding population and reduces the potential of sharing patients between hospitals to spread the workload. Moreover, it is not as easy for Norwegian hospitals to specialize and regulate their case-mix as their Dutch counterparts. They must accept all the patients coming in, which entails an intrinsic variability in the care process.

Conclusion

The main challenge faced by the Dutch and Norwegian healthcare system is the same: an aging population and an increase in co-morbidity. In both countries there is a need to work differently and smarter. Introducing ICM could contribute to this. There are however some differences between the Dutch and Norwegian system that can affect the outcomes of implementing ICM. First, the economic incentives to plan smarter are lower in Norway than in the Netherlands. This effect could be compensated by a stronger central steering in Norway. Second, the Norwegian geography hampers the possibility to share patients among hospitals and to have specialized hospitals for specific patient groups. This implies that Norwegian hospitals need to deal with more natural variability. Overall, the success of implementing ICM in Norway could be less than in the Netherlands due to the mentioned differences between the healthcare systems. However, there is still great potential for improving the current way of planning in Norwegian hospitals, and we believe ICM can highly contribute to this improvement.

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1 Introduction

1.1 The need for change

Healthcare is under pressure due to an aging population with increasing co-morbidities. As a result, we see an increase in healthcare expenditures and required staffing [2]–[6]. Increasing healthcare budgets and employing more personnel is not sustainable. The healthcare sector needs to work smarter to re-organize processes for efficiency and effectiveness, and to achieve more with the same budget and staffing levels.

This problem is not exclusively a Norwegian problem. Many western societies face the same challenges. In the Netherlands this has resulted in the development of a new way of managing capacity: the Integral Capacity Management (ICM) approach. This approach has been successfully implemented in several Dutch hospitals, and it seems a promising approach also for the Norwegian health sector.

1.2 The iCope project

iCope is an NFR-funded project lasting 3 years which seeks to implement ICM in Norwegian hospitals. The project works with the objective to break through the silo-ed organization of hospital departments to establish integral planning and control of care chains. This means that the planning and control is done to promote “patient flows”, taking into account all the different departments and how they are connected, as well as the different specialties. This approach allows hospitals to improve the quality and timeliness of care while containing costs.

Several organizations are partners in the project: Helse Midt-Norge RHF, Helse Møre og Romsdal HF, SINTEF, Rhythm BV, University of Twente, NTNU and ORTEC BV.

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To write this report and summarise the essentials of ICM we have a) looked at the scientific literature in books, journal articles and PhD theses, and b) used our own knowledge and experience gained from following ICM-related courses and attending presentations from the professionals in the field. To describe and compare both healthcare systems, we have looked at reports, national databases of statistics, and news articles.

1.5 Structure of the report

The report is structured as follows:

In chapter 2 we explain the basis of ICM. We first go through its vision (section 2.1) and motivation for implementing this novel approach (section 2.2). We then continue by describing how variability affects processes and how it is related to planning (section 2.3). Afterwards we explain what integral planning and control is (section 2.4), and how ICM integrates three different dimensions (section 2.5). We then highlight one of the key assets of ICM which is tactical planning (section 2.6). Afterwards, we show two examples of successful implementation of ICM in the Netherlands (section 2.7), and we finish the chapter with a recap of ICM (section 2.8).

Chapter 3 provides a description of the Dutch and Norwegian healthcare systems, with a focus on the organization of somatic curative hospital care. The systems are described on three different factors: governance structure (section 3.1), funding (section 3.2) and social geography (section 3.3).

Chapter 4 compares both systems on the aforementioned factors and highlights what factors can act as drivers or barriers in the implementation of ICM in Norway.

Last, the conclusions are presented in chapter 5.

2 Integral Capacity Management

2.1 Vision of ICM

The vision of ICM is to be in control in matching patient demand with the hospital's available capacity to achieve the hospital's objectives, without increasing capacity, through reducing and managing variability.

2.2 Motivation for ICM

Effective and efficient delivery of care is very complex. Hospitals face many daily challenges, such as surgery cancellations, last minute changes in schedules, overtime, long wating lists, unbalanced workloads, under or over utilization of resources, etc. All these problems are normal and frequent in hospitals, and they are often the result of a mismatch between demand for care and resource capacity. Moreover, they also reflect other problems at higher levels that require attention.

First, there is an ever-increasing spending in healthcare [7] which is often used as an excuse for not changing the old established ways of working in hospitals. This results in an upscaling of the inefficiencies as more money is put into the system, but the root causes of the problems are not addressed. For example, not changing the way hospitals plan because "we have always done it this way", and instead hiring more staff to reduce waiting lists and overtime does not solve the root cause of the problem, it only serves as a costly band-aid.

Second, hospitals are organized in silos where each department has its own planning and management, and there is a lack of collaboration for planning together. Often the most expensive department is optimized (the Operating Room (OR)) and all the other departments must follow, which creates a lot of variability upstream and downstream the care chain. For example, optimizing the OR individually and making a surgical plan without considering the wards can lead to waiting time for patients and unbalanced workloads in the wards, needing extra nurses at some times and having too many at others.

Third, the different departments and specialties in hospitals have very different objectives they want to achieve. Not having a joint mission, and therefore a clear set of objectives as a hospital, makes it very difficult to know what the hospital should work towards, and results in misalignments that create inefficiencies.

Tackling all the above-mentioned problems requires a change in the governance structure and culture of the hospital. New ways of planning and control that interconnect different departments and enable shared planning are needed. Making capacity related decisions at the right time and having a comprehensive view of the hospital will reduce many of the problems that hospitals experience daily.

ICM comes in as an approach where the hospital is seen holistically (Figure 1). The departure point for ICM is determining what performance the hospital strives for, which is a trade-off between quality of care, labour, service and efficiency. Management and all the departments and specialties work together with a common objective and with a helicopter view of the hospital to make capacity related decisions at different time frames, to ensure that the hospital achieves its objectives with the existing resources without increasing costs.

Figure 1. Helicopter view of the hospital [8]

2.3 The role of variability

In an ideal world there would be no variability. Patients would appear at a constant rate, with the same degree of illness and would respond equally to treatment [9]. Without variability, care demand and resource capacity could always be matched, and it would be possible to achieve a 100% efficiency with no patients waiting, no overtime and a constant work pressure. But variability exists and it needs to be addressed to ensure that the right care can be delivered to the right patient, at the right time by the right team.

Variability can be present in any process in two forms: natural and artificial. It is important to understand the differences between these two to be able to tackle them, as they impact the care process differently and the way to manage them is different. As [9] describes, natural variability occurs randomly and comes intrinsically from the clinical needs of the patients. It is not possible to fully eliminate it, but it can be predicted. On the other hand, artificial variability is created as a result of system processes or human interventions. It often arises from well-intentioned practices but has the consequence of creating peaks and valleys both in patient demand and resource capacity [9]. This variability is extrinsic to the care process, it is not random, and it can often change. Therefore, it cannot be predicted, it can only be eliminated by changing the way of working.

On the one hand, an example of natural variability is the arrival of patients to an out-of-office-hours service in the hospital ("legevakt" in Norway, "huisartsen post" in the Netherlands, or the Emergency department (ED) in other countries). When having urgent medical problems, patients seek medical help and arrive at different times of the day and days of the week. The service will experience demand fluctuations over time, which can be predicted as shown by [10]. Another example of natural variability is the increase of fractures and subsequent need for medical attention during severe weather which can also be predicted [11]. On the other hand, artificial variability can be exemplified by elective patient scheduling practices. As [9] explains, these practices often introduce significant variability. For example, in the OR there is a big difference among days of the week, where oftentimes Mondays peak in the number of cases while Fridays have less volume. Moreover, one Monday case volume can be completely different from another Monday, and this is just the result of decisions made to allocate resource capacities and schedule patients.

Unfortunately, the consequences of artificial variability tend to have a bigger and more negative impact for hospitals on a daily basis than natural variability. Continuing with the artificial variability example of elective scheduling in the OR, this variability in the OR will further impact the wards,

creating peaks and valleys in patient demand, resulting in a mismatch with the available staff. This will lead to staff experiencing stop-and-go operations, which means to run and stand still, having to sometimes work very hard to attend many patients and other times having nothing to do. Variability leads to waiting time, overtime, and idle time. The good news of having artificial variability though is that it can be changed because, as mentioned before, it is a result of human decisions. Making such decisions differently can have an impact on the staff's working conditions, the patients' quality of care and the productivity for the hospital.

Planning is therefore a necessity to address variability. Planning is in fact *variability management*. The different stakeholders in the care process seem to have contradictory objectives. While management wants to maximize utilization, staff wants to have enough time to see the patient, but they want to minimize the overtime, and patients want to minimize their waiting time. If variability is not tackled, only striving for one of these objectives will hinder the achievement of all three objectives, whereas when managing variability, the three objectives can be met at the same time.

Let us explain the effects of variability with the principle of maximizing utilization (the objective from management mentioned above). Imagine that the outpatient clinic has a fixed resource capacity and a workload that varies over time, per design never exceeding the maximum capacity (Figure 2a). Some of their capacity will go unused (blue area in Figure 2a), so they decide to reduce the wasted capacity by increasing the number of patients accepted (i.e., increasing the workload). Adding more workload because there is spare capacity will not result in a higher utilization, but will lead to less unused capacity at some times and to a severe lack of resources at others (Figure 2b). This will result in more patients waiting, higher work pressure, lower productivity, lower service, and a lower utilization. An alternative method to increase utilization is to manage variability. Eliminating the artificial variability and reducing the remaining one will lead to a higher utilization with less capacity, reduced overtime, more patient flow and thus reduced waiting (Figure 2c). If there is non-avoidable variability, this variability in the workload can be followed by the capacity by using flexibility (Figure 2d), which leads to the same effect as the previous approach. This last approach requires good predictions and the use of flexible capacity.

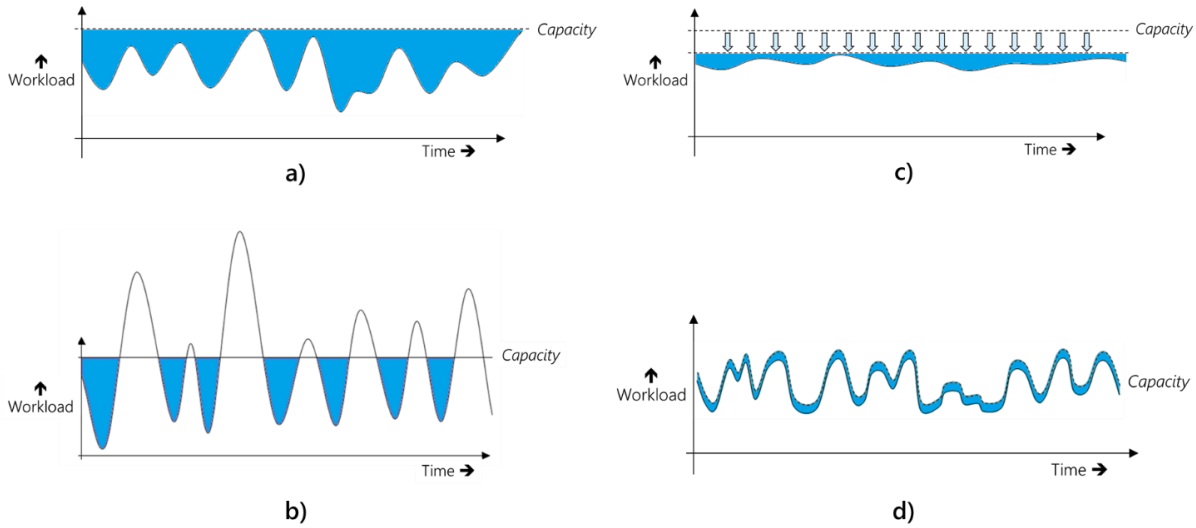


Figure 2. Dogma of maximizing utilization (a and b) and variability management to match patient demand with resource availability (c and d). Adapted from presentations given by E.W. Hans from CHOIR [12].

This flexibility is the ability of an organization to specify and adjust planning decisions as close to the moment of actual care provision as possible, because this is when the most information is available [13]. This results in a better match between care demand and care supply. Examples of flexibility are: making additional capacity available, moving activities to earlier or later times, working different under time pressure, etc.

Summarizing, planning is to create and cleverly use flexibility to deal with variability and variations in demand and supply. The aim is to work smarter, not harder, by improving capacity planning and control. When planning capacity, we want to reduce artificial variability and predict and anticipate the remaining variability using flexibility.

2.4 Integral planning and control framework

There are two main approaches for organizational improvement, namely the top-down and bottom-up approaches. The bottom-up approach focuses on creating a culture of continuous improvement, where those working daily on the field can provide significant insight that management might fail to notice. All the bottom-up methods have in common the waste, variability and complexity reduction, and value maximization. However, as Oren Harari said, "the electric light did not come from the continuous improvement of the candle". Therefore, despite these bottom-up methods being useful, a top-down approach to change the current operating model in hospitals is necessary. As we will see, ICM is a top-down approach, but it is still compatible with bottom-up methods, and it is essential to get those working on the field involved.

ICM is based on the healthcare planning and control framework (Figure 3) developed by [1]. This framework integrates all managerial areas in healthcare delivery operations and all hierarchical levels of control commonly used in the manufacturing industry. Such integration ensures completeness and coherence of responsibilities for every managerial area [1].

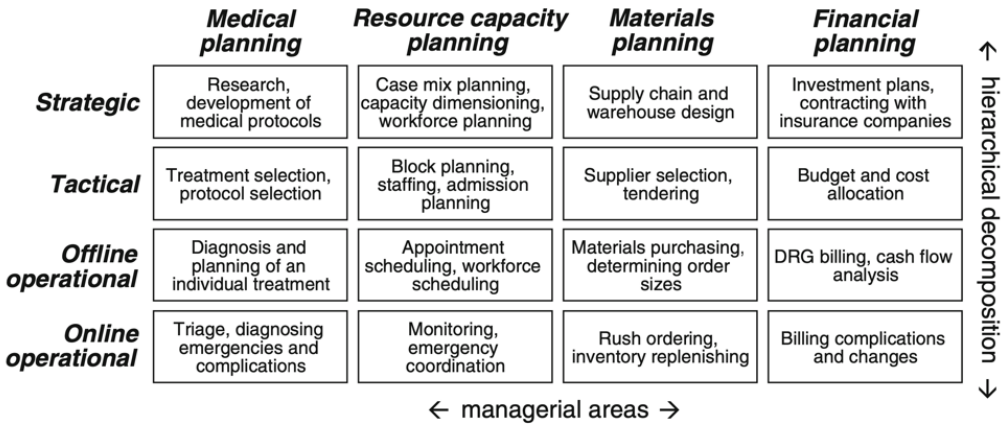


Figure 3. Healthcare planning and control framework [1]

2.4.1 Managerial areas

The framework includes four managerial areas, namely *medical planning, resource capacity planning, materials planning* and *financial planning*. Medical planning entails the decisions made by clinicians regarding medical protocols, (new) treatments, diagnoses, triage, etc. Resource capacity planning comprises the dimensioning, planning, scheduling, monitoring and control of renewable resources, such as equipment and facilities as well as staff. Material planning addresses the acquisition, storage, distribution, and retrieval of all consumable resources/materials like suture materials, prostheses, blood bandages, etc. Financial planning addresses how an organization should manage its costs and

revenues to achieve its objective under current and future organizational and economic circumstances [1].

2.4.2 Hierarchical decomposition

The framework organizes the planning and control functions hierarchically, reflecting the natural process of increasing disaggregation in decision making as time progresses and information gradually becomes available [1]. The four hierarchical levels of control are: *strategic, tactical, offline operational and online operational.* The strategic and operational levels are more tangible and more known within hospitals than the tactical one. Therefore, they are also easier to explain and understand. Since ICM focuses on capacity management, we will provide examples of the hierarchical decomposition from the resource capacity planning managerial area. For examples of other managerial areas see [1].

The strategic level is the building brick of the organization as it addresses structural decision making. These are long-term decisions based on highly aggregated information and forecasts. In the resource capacity area, the strategic level translates strategy to strategic capacity decisions concerning structural design, dimensioning, and development of the healthcare delivery process [14]. Examples of strategic capacity decisions are case-mix (i.e., patient types and volumes) or expansion of resource capacity such as acquisition of new MRI machines, hiring more staff or building a new OR.

Operational planning involves the short-term decisions related to the execution of the day-to-day healthcare delivery process, where both demand and capacity are known [14]. At this level the flexibility is low as decisions made at higher levels have delimited the scope of the decisions at the operational level [1]. The off-line operational level entails the coordination of the activities of elective demand *in advance* (before the day of care). Examples are patient appointment scheduling and nurse rostering. On the other hand, the online operational level comprises control mechanisms to react to unforeseen or unanticipated events [1] on the day of care itself, such as add-on scheduling of emergencies or schedule adjustments as a result of last moment sickness.

The tactical level lies between the strategic level, which sets the stage, and the operational one, which addresses the execution of the process [1]. Decisions at this level in the resource capacity area focus on periodical capacity dimensioning through allocation of resources (e.g., blueprint scheduling) and workforce [14]. It is somewhat similar to the off-line operational level, but decisions are made more in advance. At this level there is more flexibility to make decisions than at the operational level, it is also less detailed and has less demand certainty. For example, capacity levels such as extra shifts, overtime or capacity reallocation can be temporarily adjusted at the tactical level, whereas they are fixed at the operational level. The opposite stands when compared to the strategic level.

An explicit horizon length is not set by [1] for any of the hierarchical levels, given that this depends on particular characteristics of the application the framework is used for. In the iCope project, the strategic horizon is 1 year ahead, the tactical horizon length is between 3 months and 4 weeks before the day of care, and the operational horizon approximately between 4 weeks and the day of care.

2.5 Integrating capacity management on three dimensions

ICM integrates the following three dimensions: 1) the entire care chain of the patient, 2) the hierarchical levels of control, and 3) the managerial areas.

Encompassing the entire care chain of the patient consists in aligning and coordinating capacity across departments and organizations to create flow and optimize the care pathway [14]. Without inter-departmental coordination, downstream departments observe fluctuations in demand, and by trying

to solve it through the addition of capacity they create even more variability in their downstream departments. This effect causes patients to wait, and staff to experience stop-and-go operations. With cross-departmental planning, management, and control, patients flow through departments without interruptions. Capacities scale up and down in parallel, resulting in minimal under- and overutilization, minimal waiting for patients and a stable workload.

The integration of the hierarchical levels of control enables the alignment of strategy and operations. Top-down integration of decisions is necessary to ensure that strategy is properly translated into operations as each level demarcates the underlaying level by setting resource levels, production targets and planning objectives [14]. The flexibility organized on higher levels makes the organization agile enough to deal with more detailed information at lower levels. However, bottom-up integration is also crucial in order to provide feedback from the operational level to the strategic level, and thus, be able to solve problems structurally. Not escalating the problems to a higher hierarchical level, and therefore not solving them structurally, leads to a myopic optimization which results in stop-and-go operations, waiting times and inefficient resource utilization. Hierarchical integration is therefore an iterative process as bottom-up integration feeds new strategy development, and top-down integration facilitates strategy execution [14].

Finally, integrating several managerial areas allows for a proper redesign and optimization of the healthcare delivery process [1], without overlooking domains. Not taking into account other areas when making decision (for example, financial and capacity) may result in unbalanced workloads [14]. The integration of managerial areas in ICM therefore aims to align decision-making processes between managerial areas such that the impact on capacity is integrally analysed [14].

2.6 Planning on the tactical level

One of the main characteristics of ICM is that it introduces the tactical planning level which hospitals usually overlook when planning and managing their capacity. The decision-making process of hospitals is still not systematically managed. Oftentimes hospitals jump from strategic decisions to operational firefighting, and tactical decisions are rarely taken. This causes a misalignment between demand and supply. Tactical decision-making is therefore essential to translate the strategic goals into operational capacity. Otherwise translating strategic horizons of at least one year to operational horizons of a couple of months is extremely difficult [14]. For example, the strategic decision regarding the number of surgeries for a specialty in a year (production budget) should be translated into the number of surgeries per period (e.g., month) at the tactical level (production plan), and then into number of expected surgeries per day at the operational level (production schedule).

In ICM, capacity planning and management decisions are made hierarchically with feedback on performance. The idea is to make decisions at the right moment by the right person in line with the strategic goals, and not just last-minute (operational) decisions which result in less flexibility. To do that, a structured yearly cycle with planning meetings is necessary to optimally align all capacity decisions in the care chain (Figure 4). The yearly cycle encompasses from yearly and quarterly strategic and budget meetings to monthly tactical meetings, and weekly operational meetings. At the strategic level, decisions need to ensure enough capacity. At the tactical level, decisions allocate capacity to patient groups that need it, when they need it. At the operational level it needs to be determined within patient groups which patients need the capacity and deals with natural variability.

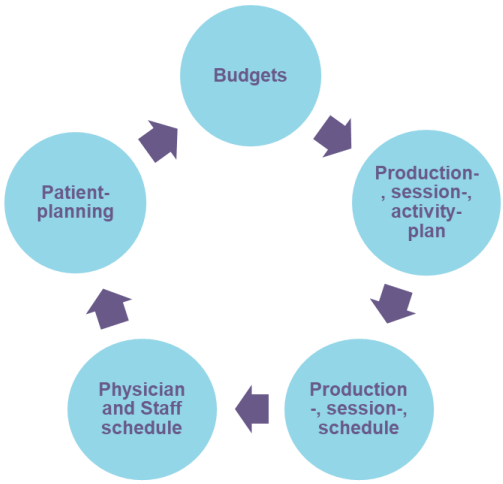


Figure 4. Yearly cycle with strategic, tactical, and operational meetings to optimally align capacity decisions. (Illustration from the ICM training course given by Rhythm BV [13])

Capacity-related decisions are supported by the use of dashboards. These dashboards are built using Operations Research methods for analysis, forecasting and optimization, and the results are visualized in tables and graphs. The dashboards are loaded with hospital data, which most times needs to be adapted as it is oftentimes used for other purposes (financially mainly). It is also common to not have the type of data required, and thus, to have the need to generate it from other data. Requesting, obtaining, cleaning, and verifying data is a long, slow, and tedious process which is usually underestimated, and can often cause serious delays in projects. Having available, transparent and reliable data is key for a successful implementation of ICM.

During tactical planning meetings (TPM), as mentioned above, decisions are made to allocate capacity to patient groups that need it when they need it. Topics that are addressed at the tactical level are, among others [13]:

- Determine the leave plan: holiday periods, maintenance of ORs, specialist conference, etc.
- Prepare the session plan or master surgical schedule (MSS) to divide weekly sessions over specialties
- Determine the activity plan for specialists, i.e., the hours each specialist has to dedicate to each type of activity over a period (e.g., month).
- Determine rules about timely returning and/or reallocating sessions to specialties
- Monitoring access times and production
- Adjust the session plan due to reduced weeks, surgeon days, etc.

All decisions taken during the TPM are supported by the use of dashboards showing realized and forecasted performance. Analysing the performance of realized periods will be helpful for learning what went wrong or worked properly and determine how far the hospital is from achieving its objective. Using forecasts of production goals, waiting lists, etc., will allow for timely capacity adjustments and determining whether the hospital is expected to land within budget at the end of the year. At this point, demand is not totally known, and therefore it is (partly) forecasted based on seasonal demand, waiting list information and the downstream demand of patients currently under treatment [1].

Let us make an example of a planning and scheduling cycle for one specialty in the OR (Figure 5). Let us say we want to make the OR planning for a period of 4 weeks. Given all the strategic decisions and targets, the planning timeline is as follows:

- *12 weeks before the period*: This is the moment we start to update the session plan, where we modify the OR blueprint (MSS). It is necessary to know in advance the leave requests (holidays, conferences, lectures, etc.). We then investigate whether we are realizing the budget, determine the number of sessions we need to plan for the OR and outpatient clinic and what surgeon should be doing what session. All this is determined in one tactical planning meeting.
- *10 weeks before the period*: Next, the session schedule is adjusted, and the physician and staff schedule made.
- *8 weeks before the period*: Another tactical planning meeting takes place where we check whether we were able to schedule everything, whether we need to change anything in the session plan and whether the workload and schedule for staff is appropriate. Then, the session, physician and staff schedules are published. This means that, ideally, they are locked since, if everything is planned properly, only last-minute modifications due to unforeseen events (given by natural variability) will be needed. If bigger modifications are needed, there is still enough time for adjustment. Once the schedules are locked and published, the patient appointment planning can start and will last until the end of the planned period.

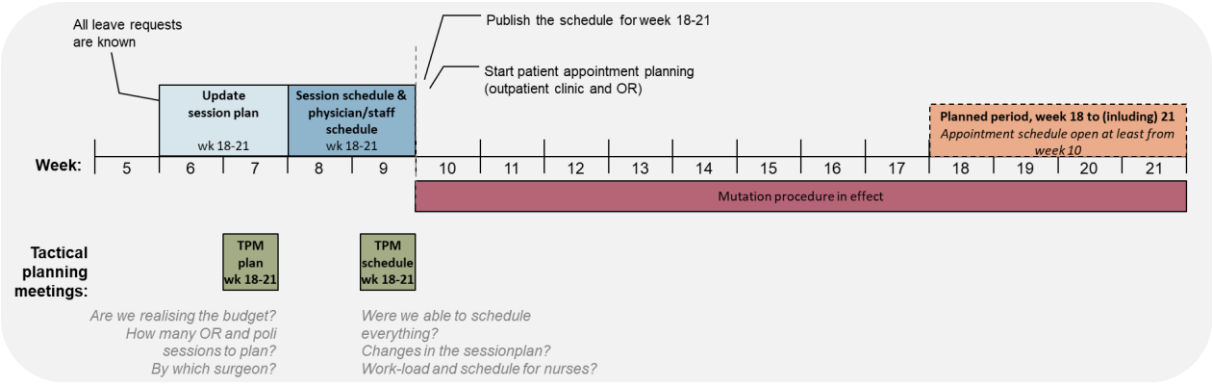


Figure 5. Example of the planning and scheduling cycle of one specialty in the OR to illustrate tactical planning decision-making. (Illustration adapted from the ICM training course given by Rhythm BV [13])

Since physicians work across many departments, their schedules have a major impact on the workload of multiple departments. Therefore, making physician schedules with enough time (10-12 weeks in advance) and locking them (i.e., not allowing major changes unless necessary) is key to properly plan all the other capacities involved in the care delivery process. Currently, physicians might not be aware of the amount of re-planning that is required when they decide to change their program. When schedules are not provided to departments with enough time, these departments will have to make assumptions on, for instance, the number of rooms needed for a specialty on a day in the outpatient clinic, but eventually only one out of three physicians that were assumed to work shows up and two rooms remain empty. Therefore, not only is it essential to make, lock and provide the schedules on time, but it is also fundamental to communicate planning decisions between departments so that capacities can be aligned.

2.7 Success of ICM in the Netherlands

Several hospitals in the Netherlands are implementing ICM. Four examples are Sint Maartenskliniek in Nijmegen, OLVG in Amsterdam, Martini Ziekenhuis in Groningen, and UMC Utrecht. Results from Sint Maartensliniek and OLVG Amsterdam are described below.

Sint Maartenskliniek (SMK) is a specialized hospital leader in the treatment of disorders in the field of posture and human movement. Their four fields of focus are orthopaedics, rheumatology, rehabilitation medicine and pain relief. SMK started the journey with ICM in 2014 and founded the department of Healthcare Logistics in 2015. Since then, they have worked on educating all the stakeholders and on starting ICM programs in orthopaedics, rheumatology, and rehabilitation. By implementing ICM, SMK has reportedly achieved:

- 10% reduction of bed capacity in the wards
- 19% increase in the number of surgeries performed
- 9% increase in the adherence to the physiotherapy treatment protocol
- 27% in the percentage of days with the correct staffing level in physiotherapy
- 8% increase in the physiotherapy productivity
- 30% decrease in the number of consultations re-scheduled at the outpatient clinic
- 20% decrease in the number of roster mutations at the outpatient clinic
- 25% decrease in the access time to elective surgery

OLVG Amsterdam is a top clinical academic hospital in Amsterdam. OLVG embarked on a journey to implement ICM in 2020, starting with the geriatrics subspecialty of internal medicine. They continued to implement ICM in haematology and oncology. The first project they carried out was to improve the geriatrics outpatient clinic, where they reportedly achieved:

- 6% increase in the number of sessions
- 47% increase in the session utilization
- 14% increase in the number of new-patient slots
- Reduction of access times
- Even workload and sufficient time for the staff to do all the tasks
- Achieving the financial goals for 2021

2.8 Summary

Capacity planning tries to match the care demand and the resource capacity (supply) in order to reach the desired performance. This desired performance is a trade-off between quality of care, labour, service, and efficiency. Good healthcare logistics requires the formulation of clear and measurable goals, and to take into account the entire patient journey.

Finding the right balance between demand and supply is very complex because there are endlessly interlocking decisions. Patients flow in a supply chain of departments where each department has its own planning, and oftentimes do not consider the upstream and downstream departments when planning (silo-ed organization). The decisions made when optimizing the planning of just one department create an artificial variability which is amplified in the downstream departments. This leads to a mismatch between patient demand and resource capacity, resulting in unbalanced workloads, long waiting lists, long access times, low productivity, overtime, etc. Not managing natural and artificial variability will impede reaching the desired goals. It is essential to make variability predictable as much as possible, eliminate it and anticipate it using flexibility.

ICM helps hospitals achieve their performance goals while containing costs. This is done by creating a decision structure where planning decisions are made to align resources, taking into account the entire care pathway (all departments), different time frames (hierarchical levels of control) and different managerial areas. With cross-departmental planning, patients flow through departments without interruptions. Capacities scale up and down in parallel, resulting in minimal under- and overutilization, minimal waiting for patients and a stable workload. With both top-down and bottom-up hierarchical integration we can facilitate strategy execution at the operational level, and we can escalate problems to higher levels to solve them structurally. The integration of managerial areas aims to align decision-making processes between managerial areas such that the impact on capacity is integrally analysed.

One key asset of ICM is the introduction of tactical planning, which is often overlooked in hospitals. It enables the translation of strategic goals to operational capacity, preventing the usual operational firefighting. At the strategic level, decisions need to ensure enough capacity. At the tactical level, decisions allocate capacity to patient groups that need it, when they need it. The operational level determines within patient groups which patients need the capacity and deals with natural variability. ICM uses a structured yearly cycle with planning meetings to optimally align all these capacity decisions. The availability of transparent and reliable data is key in ICM. This data is used to fill dashboards that visualize realized situations and forecast the future demand and workload.

3 The Norwegian and Dutch healthcare systems

This chapter describes the organization of somatic curative hospital care in the Netherlands and Norway. The description is based on three factors that are related to the way the healthcare system is organized and can affect the success of ICM. These are: *governance structure*, *financing*, and *social geography.*

3.1 Governance structure

As described by the World Health Organization (WHO), the governance of a healthcare system "involves ensuring strategic policy frameworks exist and are combined with effective oversight, coalition-building, regulation, attention to system-design and accountability. Three main categories of stakeholders who interact with each other determine the health system and its governance: the state (governmental organizations), health service providers and the citizens" [15].

3.1.1 The Netherlands

The governance structure and organization of the Dutch healthcare system is summarized in Figure 6. Three markets are the core of the Dutch system: the health insurance market, the health purchasing market and the health service provision market [16]. Private health insurers negotiate with health providers such as hospitals about price, volume, and quality of care and contract them to deliver care. Simultaneously, these private insurers administer and provide basic health insurance to citizens, who have to buy it compulsorily. Citizens can then choose to use the health offered by the health providers.

The ministry of health, welfare and sport is accountable for law-making and supervision of the above-mentioned markets. Since 2006, the Dutch Healthcare Authority, an independent government body supervised by the ministry of health, has governed the hospitals with its main objective to protect the interests of the Dutch citizens regarding accessibility, affordability and quality of care, thereby ensuring a proper functioning of the health markets [17]. Together, the Ministry of health, welfare and sport and the Dutch Healthcare Authority govern the healthcare system [18].

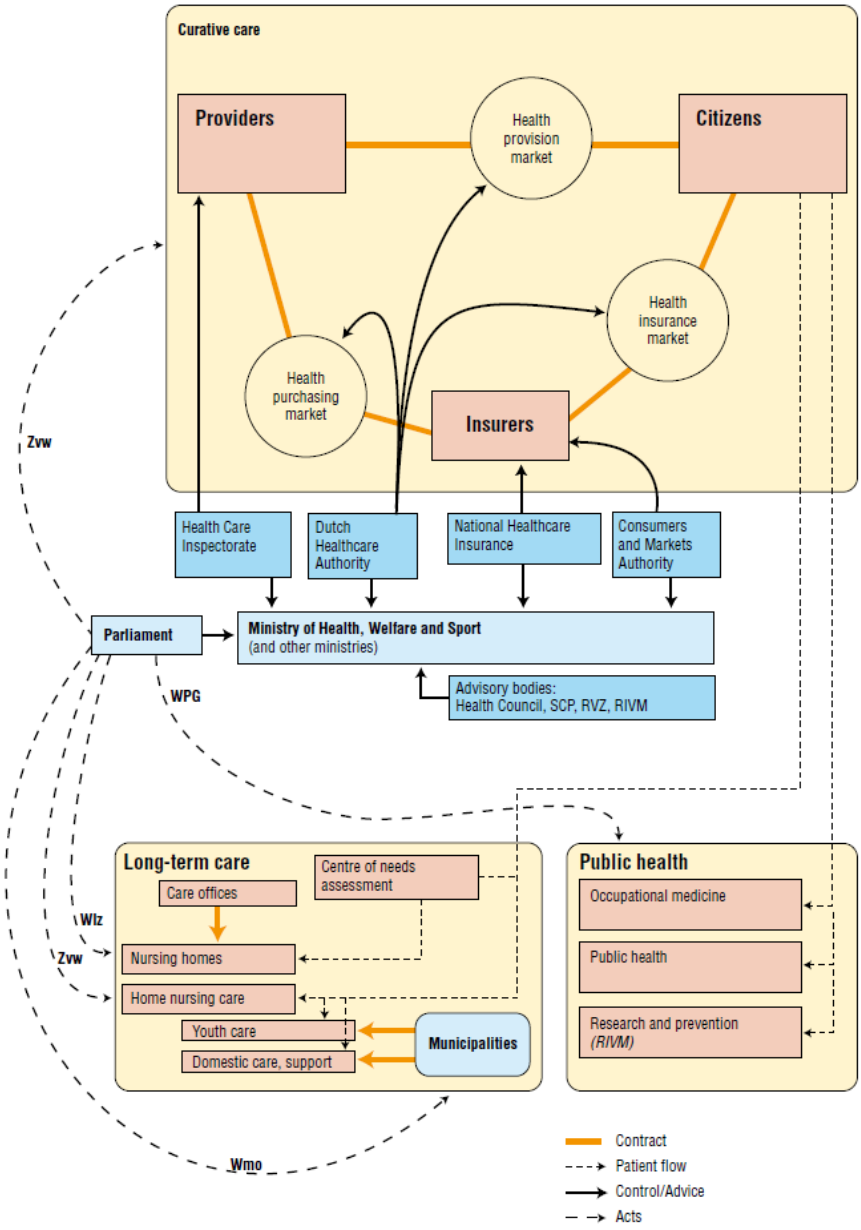


Figure 6. Organizational overview of the Dutch healthcare system [16]

3.1.2 Norway

The governance structure and organization of the Norwegian healthcare system is summarized in Figure 7. We can distinguish three levels at which health care services are organized: national, the county, and the municipality. Specialist care is organized at the national level. This is done by delegating the administrative responsibility to the four regional health authorities (Nord, Midt-Norge, Vest and Sør-Øst). These regional health authorities own the hospital trusts. Steering along the hierarchical relation from the ministry to the regional health authorities goes via budgets and letters of allocation. The counties have only a small responsibility in healthcare, for example, they provide dental care. Municipalities are responsible for providing primary care, such as: home care, nursing homes, general practitioners, etc. Both counties and municipalities are rather free in how they choose to organize this, but are controlled by the ministry by means of legislation and financial instruments.

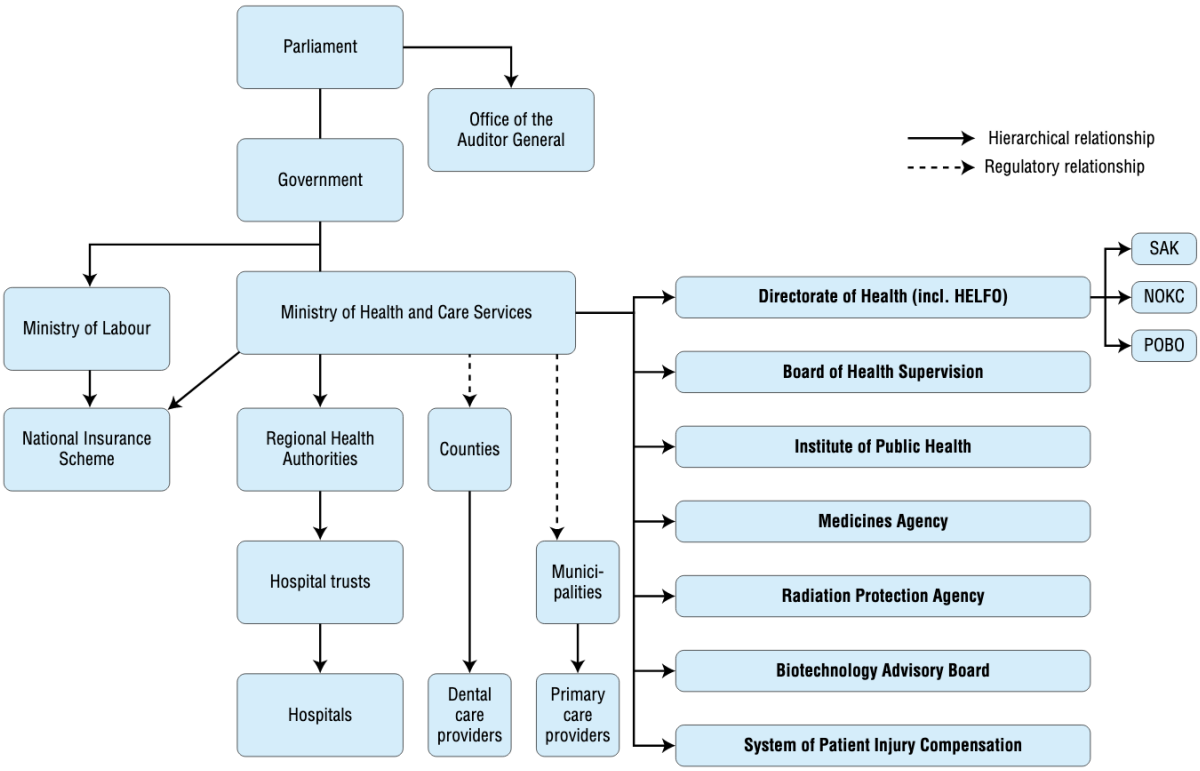


Figure 7. Organizational overview of the Norwegian health care system [19]

3.2 Financing

As described by WHO, "health financing refers to the function of a health system concerned with the mobilization, accumulation and allocation of money to cover the health needs of the people, individually and collectively in the health system. The purpose of health financing is to make funding available, as well as to set the right financial incentives to providers, to ensure that all individuals have access to effective public health and personal health care" [20].

3.2.1 The Netherlands

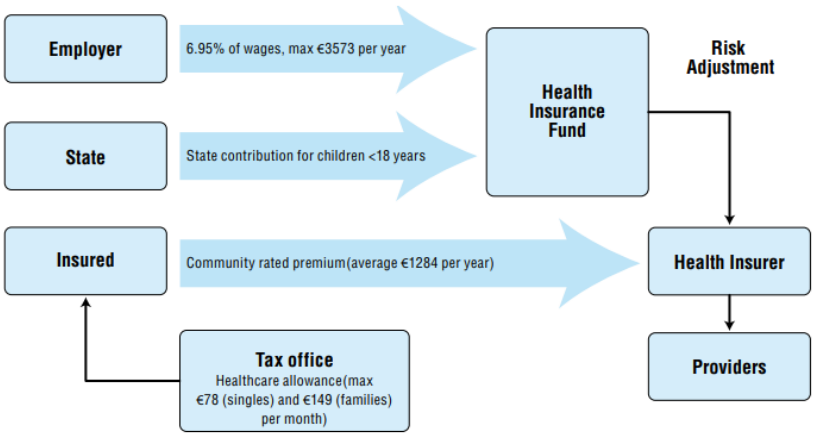


Figure 8. Simplified overview of financial flows in the Dutch healthcare system [16]

The ministry of health decides upon the national budget for healthcare. As mentioned before, private health insurers are in charge of administering and providing basic health insurance to the citizens. These insurers are funded by 1) the premium directly charged to the insured person and 2) a contribution from the Health Insurance Fund, which pools the income-dependent employer contributions (collected by the tax office), and the state contribution (e.g., to cover children under 18) [16]. While the income-dependent contribution accounts for approximately 50% of the total funding of basic health insurance, the premiums amount for the other 50% [16]. A simplified overview of the financial flows in the Dutch healthcare system is depicted in Figure 8**Error! Reference source not found.**. If providers and insurers spend more than the maximum allowed healthcare expenditure determined by the national healthcare budget, the Minister may decide to charge insurers or providers to repay the excess [16].

Hospital and surgical care in the Netherlands are 100% financed by activity-based-funding. A percentage of the activity-based funding is non-negotiable, where hospitals receive a fixed amount per treated case. The other percentage is freely negotiable between hospitals and health insurers. Since 2012, 70% of the activity-based funding comes from the negotiable ones [21].

3.2.2 Norway

Public sources account for approximately 85% of total health expenditure [19]. The private health financing comes mainly from out-of-pocket payments (outpatient pharmaceuticals, dental care, small patient fee per GP consult, etc.). Somatic specialist care is financed through block grants (60%) and partly through activity-based funding (40%, DRG based). In hospital and specialist care, the funding goes from the state to the regional health authorities, who distribute it to the hospital trusts they own.

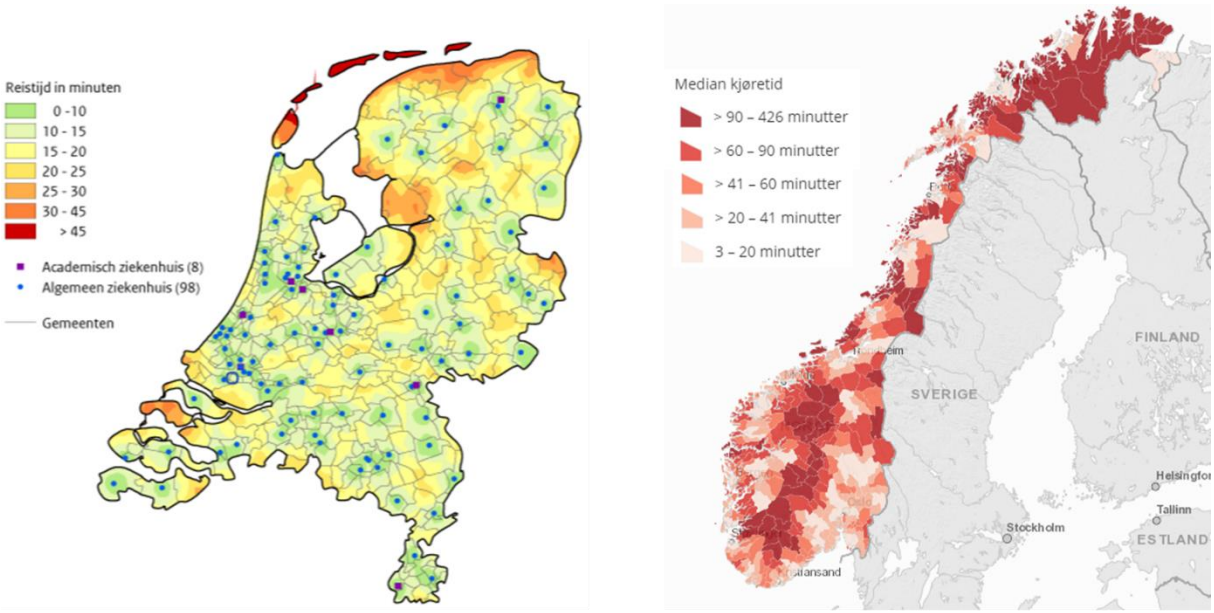
3.3 Social geography

As described in [22] “social geography is the branch of human geography that is interested in the relationships between society and space”.

3.3.1 The Netherlands

The geography of the Netherlands is unusual as part of the land has been reclaimed from the sea using dikes as protection, and therefore, a third of the Netherlands is situated below sea level [23]. Most of the Netherlands is flat terrain encompassing from coastal lowland to farmland, grassy dunes, and sandy beaches. The Netherlands extends 312 km from north to south and 264 km from east to west, with a total area of 41,865 km^2. It has a population of 17.7 million inhabitants in 2022, making it one of the most densely populated countries in Europe at 423 people per km^2 [24].

The average distance from a household to a hospital was 4.2 km in 2019, varying from 1 km in the Randstad region, where the country is most populated, to a maximum of 63 km in one of the islands in Friesland [25]. The Netherlands also calculated the average number of hospitals within a certain radius. In 2019, 0.6 hospitals where within a radius of 5 km, 1 hospital within a radius of 10 km and 3.5 hospitals within a radius of 20 km [26]. Figure 9a shows a distribution of the travel time to the nearest academic or general hospital per region in the Netherlands. In most regions, citizens can get to a hospital within 25 minutes.



a) b)

Figure 9. a) Travel time to the nearest academic or general hospital in the Netherlands [27], b) Median driving time to the nearest emergency department in Norway [28]

3.3.2 Norway

Norway is a very long and narrow country that extends 1700 km from south to north [29], and has an area of 385,207 km^2 [30]. Most of the country is dominated by mountainous or high terrain with a very varied topography, from glaciers and lakes to fjords and islands. Norway has an estimated population in 2022 of 5,42 million inhabitants. Given its big dimensions and low population, Norway has one of the lowest population densities in Europe at 14 people per km^2 [30].

Due to Norway's dimensions, hospitals are at long distances from each other, each of them having to serve the population surrounding it. In 2019, the average distance from a household to a Norwegian hospital was 18.4 km, even though this value is not very representative given that the country's population density varies substantially depending on the region. In higher populated areas like the south of Norway the average distance to a hospital is 6.3 km, whereas in the northern region of Finnmark it is 144 km [31]. Moreover, given the varied Norwegian topography, driving times are longer than in other countries, and in some areas the population is highly dependent on ferry transportation. Getting to the closest hospital can take from 10 minutes in the Oslo area to more than 2 hours in Finnmark [31]. Figure 9b shows the median driving time to the nearest emergency department (which can be used as a proxy for regional hospital location) per region in Norway.

4 Drivers and barriers for the successful implementation of ICM in Norway

Some of the drivers for ICM implementation highlighted by the hospitals in the Netherlands are internal factors, such as leadership and autonomy, commitment in the organization, education and empowerment, communication, trust, information systems support, and data analysis and modelling capabilities. All these factors are common to most organizational change efforts and play a key role in the success of ICM implementation. Moreover, the external factors presented in the chapter 3, which are related to the characteristics of the organization of the healthcare systems, have acted as drivers for the successful implementation of ICM in the Netherlands. Some of these factors could act as barriers in the case of Norway.

4.1 Governance structure

Most of the Norwegian hospitals are publicly owned and steered by the regional health authorities. Instead, in the Netherlands hospitals have high autonomy as the board is the responsible for steering and negotiating production levels and pricing with the insurance companies and achieving production within budget. For that, the board of the Dutch hospitals acts as the central steerer and encourages cross-departmental planning to achieve the hospital's performance objectives. Despite both systems being different and Norwegian hospitals not being solely steered by their board, the Norwegian governance structure does not necessarily imply a barrier. The ownership and steering of hospitals in Norway by the regional health authorities means that they also have steering ability to change and direct hospitals to go into certain directions. If used properly, this steering power has the potential to be strongly centralized, which facilitates the success of ICM. In fact, this ability of centrally steering hospitals into certain directions does not exist in the Netherlands, except for when quality indicators are below the required minimum and then the health care inspectorate comes into play.

4.2 Financing

While in the Dutch system hospitals are 100% reimbursed based on their activity, Norwegian hospitals are funded by a 60% lump sum payment and a 40% productivity related (DRG) payment. This means that changes that improve the production of hospitals will be reflected in the entirety of the Dutch budget, whereas only in 40% of the Norwegian one. Moreover, 70% of the activity-based funding in the Netherlands comes from negotiations between hospitals and insurers on production and costs levels, and insurers directly pay health providers. Contrarily, in Norway funds are not negotiated as in the Netherlands and are paid by the government to the regional health authorities who choose how to distribute it to the hospitals they own. All this creates high incentives in Dutch hospitals for reaching production while minimizing costs, whereas in Norway such economic incentives are lower. The economic incentives being lower in Norway could suppose a barrier, but they should not be taken as an excuse for not adopting ICM, as ICM also helps improving the quality of the patient care and labour.

4.3 Social geography

While Norway has a very extensive area, a challenging topography, a low population density and a sparse population separated by long distances, the Netherlands is a small and densely populated country with short driving distances in comparison. In the Netherlands most live near one or more hospitals, which implies that a) hospitals have the possibility to share patients to spread the workload and b) that hospitals can specialize by focusing on a specific patient group. Both strategies help reduce variability and improve planning. Instead, due to the geographical situation in Norway, it is not easy for hospitals to specialize and regulate their case-mix, as they have to accept all the patients coming in. In fact, specialization of hospitals in Norway could incur a lower service and quality of care for the

patient and hinder access to healthcare, to a higher degree than in the Netherlands. Unlike in the Netherlands, the geography and case-mixes in Norway will not contribute in favour of ICM. This means that Norwegian hospitals have to deal with more natural variability, and therefore the outcomes of the implementation of ICM might not be as pronounced as in the Netherlands. Nevertheless, the presence of more natural variability in Norway should not be seen as a barrier to not implement ICM in Norway, because as explained in chapter 2, the most problematic type of variability is the artificial one, and ICM focuses on managing it.

5 Conclusions

In this report we have explained ICM and highlighted its main characteristics, compared the main differences between the Dutch and Norwegian healthcare systems, and identified drivers and barriers for the implementation of ICM in Norway.

In chapter 1 we have seen that the main challenge faced by the Dutch and Norwegian healthcare system is the same: an aging population and an increase in co-morbidity. In both countries, there is a need to work differently and smarter.

In chapter 2 we have seen how ICM can contribute to working smarter. ICM is an approach that helps hospitals achieve their desired performance by matching patient demand with resource capacity through managing variability without increasing costs. Given that this approach has been successful in the Netherlands, we wanted to explore how it could be applied in Norway and analyse whether the differences between both systems could affect the outcomes of implementing ICM in Norway.

In chapter 3 we have compared the Norwegian and Dutch healthcare systems on three factors that are related with the characteristics of the systems: governance structure, financing, and social geography.

In chapter 4 we have analysed the drivers and barriers for the successful implementation of ICM in Norway, based on the mentioned factors. We have concluded two things. First, the economic incentives to plan smarter are lower in Norway than in the Netherlands. This effect could be compensated by a stronger central steering in Norway. Second, the Norwegian geography hampers the possibility to share patients among hospitals and to have specialized hospitals for specific patient groups. This implies that Norwegian hospitals need to deal with more natural variability.

Overall, the success of implementing ICM in Norway could be less than in the Netherlands due to the mentioned differences between the healthcare systems. However, there is still great potential for improving the current way of planning in Norwegian hospitals, and we believe ICM can highly contribute to this improvement.

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